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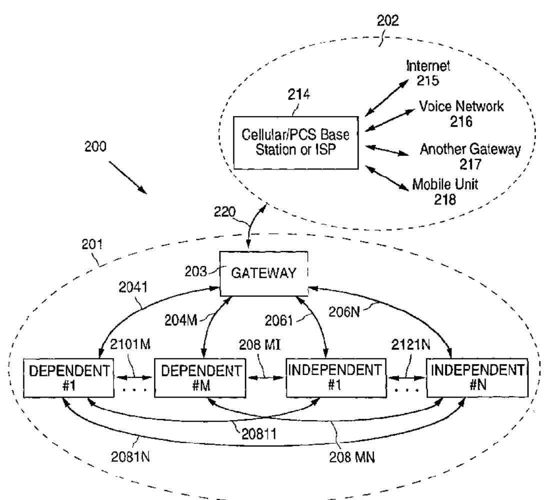
(54) **Title:** INFORMATION GATEWAY SYSTEM AND METHOD



(57) Abstract: Device and method for communicating between a plurality of devices. A communication device is partitioned into various units, each performing a function of the communication device. A subnet is established for the units, the units including a master device acting as the master of the subnet and performing an exclusive master function and a plurality of slave devices acting as the slaves of the subnet and performing other functions of the communication device. The master device negotiates with the slave devices and intelligently routes a message to the slave devices having capability to process the message. In one embodiment, the message is from an external network. In one embodiment, the message is from a slave device in the subnet. The same protocol is used for communicating with the master device. In one embodiment, the master device communicates with a slave device via a wireless communication path such as radio frequency and InfraRed. The external network is an established network, such as an internet, a mobile unit, a voice network, or another subnet.

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INFORMATION GATEWAY SYSTEM AND METHOD

FIELD OF THE INVENTION

This invention relates to networking of electronic devices. More particularly, this invention relates to networking of local electronic devices with an external network using a common gateway.

BACKGROUND OF THE INVENTION

In recent years, the networking ability has increased in dramatic fashion to include a variety of electronic devices, such as cellular phones, televisions, stereos, etc. Accordingly, cost and complexity must be added to these electronic devices to make them "internet-ready" or "network-capable." Several technologies have been used to make an electronic device network-capable, including wired and wireless connections.

One example of wired connections is the use of routers to connect various networks that would otherwise remain separate. Routers connect networks using a variety of methods and perform functions such as verifying the validity of the data packet, consulting a data structure called a routing table to see where the data packet should go next, queuing the data packet for delivery, forwarding the data packet and exchanging routing information with other routers. Typically a message being routed has an associated destination address called a MAC (Media Access Control) address which the router uses to direct the message. The router does not have the intelligence to decide where the message should go, but merely directs the message to the destination where the sender wants the message to be delivered.

The router can be a wireless router. A wireless router is typically constructed of a computer platform, an Ethernet interface to a local area network (LAN), and a radio modem which changes the Ethernet data stream to a radio frequency suitable for wireless transmission. Wireless routers have similar functionality as wired routers and use MAC addresses to route messages.

A wireless system eliminates many hardware requirements and adds mobility to the user. Generally, wireless communication is accomplished through the use of InfraRed or

radio waves. The IEEE 802.11 specification provides standards for both the InfraRed and the radio frequencies. In the arena of radio frequencies, two standards have been developed, namely, "direct sequence" which uses a wide range of frequencies for data transmission and "frequency hopping" which provides data transmission utilizing both frequency and time domain variations. InfraRed signals cannot traverse walls, closed doors, etc., as radio waves can. Both radio and InfraRed schemes are expensive as they require additional circuitry and protocol processing to communicate on a wireless network because the system must be compatible with many wide area networks (WANs) and digital standards that are used for wireless data.

Bluetooth technology addresses the compatibility problem by developing a technology specification for small form factor, low-cost, short range radio links between portable devices. Bluetooth technology uses a universal bridge to existing data networks, a peripheral interface, and a mechanism to form small private ad hoc groups of connected devices away from fixed network infrastructures.

FIG. 1 shows a Bluetooth network topology. Devices 121 through 124 form a piconet 12. A piconet is a general purpose, low powered, ad hoc radio network consisting at least two linked devices, such as a portable personal computer (PC) and a cellular telephone, but can consists up to eight linked devices. All of the devices on the piconet are peer units having identical communication connections and implementations.

The first unit to establish communication in piconet 12 acts as the master and the other units act as the slaves, for the duration of the piconet connection. Network connection for piconet 12 is established as follows. Before any links in a piconet are created, all devices are in STANDBY mode. In this mode, an unconnected unit periodically "listens" for messages at its defined frequency or its defined hop sequence. The linking procedure is initiated by any of the devices which then becomes the master. A linkage is made by a PAGE message if the address is already known, or by an INQUIRY message followed by a subsequent PAGE message if the address is unknown. In the initial PAGE state, the master unit sends a train of 16 identical page messages on 16 different hop frequencies defined for the device being paged (slave unit). If there is no response, the master unit transmits a train on another 16 hop frequencies in a wake-up sequence. The INQUIRY message is typically used for finding Bluetooth devices, including public

printers, fax machines and similar devices with an unknown address. Once the network connection is established, data is sent through the network to the designated device.

In general, piconet 12 is established when communication needs to be established from or to a device in piconet 12, e.g., a waiting message for one of the devices in piconet 12; one of the devices in piconet 12 is initiating communication to another device in piconet 12; or one of the devices in piconet 12 is initiating communication to a device in another piconet. For example, in FIG. 1, communication may be initiated by device 121 sending a message to a device in piconet 14. Hence, device 121 becomes the master unit and the remaining devices in piconet 12, i.e., devices 122, 123 and 124, become the slave units.

Master unit 121 establishes the clock and hopping sequence to synchronize slave units 122, 123 and 124 in piconet 12. Each of the links 125 through 127 in piconet 12 includes logical link control (LLC) and media access control (MAC). Each of the devices 121 through 124 in piconet 12 is represented by a MAC address which is a 3-bit physical address such as those used by Ethernet and token ring to distinguish between units participating in piconet 12. When all communication to and from devices in piconet 12 ceases, piconet 12 is broken.

Piconet 12 is again established when one of the devices establishes communication. However, when piconet 12 is re-established, a different device may be the master unit instead of device 121, depending on which device establishes communication first.

Piconet 14 similarly contains linked devices 141 and 142. In one embodiment, device 141 is the master unit and device 142 is the slave unit. Hence, device 141 establishes the clock and hopping sequence to synchronize slave unit 142 in piconet 14.

Piconets 12 and 14 are independent from each other and do not have to be synchronized. Multiple independent and non-synchronized piconets, e.g., piconets 12 and 14, communicate through network connection 16 and form a scatternet 10. Network connection 16 is, for example, an ISP (Internet Service Provider).

With the configuration shown in FIG. 1, all devices are equal in terms of network awareness and capability. The devices may change roles, with one device serving as a master for many slaves, then later serving as a slave to a new master. In other words, every device must have the capabilities to be a master. In addition, for any two devices to

connect, defined profiles are required, the profile being a specific protocol. For example, a cordless telephone requires a cordless telephony profile; a headset requires a headset profile; a fax machine requires a fax profile; and so on.

A conventional gateway is typically a combination of software and hardware that connects two different networks using different protocols, or which use the same protocols but do not otherwise communicate. Some gateways, i.e., application gateways, forward data from one network to another in addition to translating protocols. Other gateways simply forward data from one network to another, without performing protocol translation. In other words, the gateway either has the intelligence to differentiate and translate different protocols or is a "dumb" channel which just passes the data to a known address.

Conventional gateways are specific to the hardware platform of the two networks, the communication protocols of the two platforms and the specific applications being run. Generally, a conventional gateway is embodied as a software resident on a Web server host, or as a software application resident on a device separate from a Web host. In the latter case, the gateway may communicate with the Web host through the Internet, or directly by other means. Examples of conventional gateways include Gopher and FTP (File Transfer Protocol), both of which are client/server protocols. Conventional gateways have the disadvantages of needing to change gateways with different applications or services.

Therefore, what is needed is a simple and inexpensive communications system to network various electronic devices.

SUMMARY OF THE INVENTION

Device and method for communicating between a plurality of devices are provided. In accordance with the present invention, a communication device is partitioned into various units, each performing a function of the communication device. A subnet is established for the units, the units including a master device acting as a dedicated master of the subnet and performing an exclusive master function of the communication device and a plurality of slave devices acting as the slaves in the subnet and performing other functions of the communication device. The master device negotiates with the slave devices and intelligently routes a message to the slave devices having capability to process the

message. In one embodiment, the message is from an external network. In one embodiment, the message is from a slave device in the subnet. The same protocol is used for all communication with the master device. In one embodiment, the master device communicates with the slave devices via a wireless communication path such as radio frequency or InfraRed. The external network may be, for example, an established network such as an internet, a public land mobile network, a POTS (plain old telephone system) network, or another subnet.

In one embodiment, the master device sends a synchronization message to the slave devices in the subnet. The master device registers a slave device by storing a device capability word of the slave device. The capability word may include, for example, data format and display resolution. in one embodiment, the master device assigns a device identification number to the registering slave device. In one embodiment, the master device sets an address in an address table if the number of slave devices is less than a predetermined maximum allowable number. In one embodiment, the master device resets an address in the address table when a corresponding slave device is disconnected from the subnet. In one embodiment, the master device assigns a group identification number to a plurality of slave devices having substantially the same capabilities.

In one embodiment, where an external network is coupled to the master device, the master device queries the external network for waiting data. If there is waiting data, the external network notifies the master device by sending a notification word which contains message type information. The master device then determines whether any slave devices in the subnet is capable of processing the waiting data. The master device then notifies the slave devices capable of processing the waiting data. In the alternative, the master device notifies one slave device that is capable of processing the waiting data. The slave device that has been notified acknowledges the master device if it is ready for a download. in one embodiment, a user selects the slave device to be used. The master device, after receiving the acknowledgment, requests a download from the external network which then sends the waiting data to the master device. The master device then routes the waiting data to the slave device. In one embodiment, the master device selects a format of the waiting data as a function of processing capabilities of the slave device.

In one embodiment, the slave device notifies the master device if the slave device is not capable of processing the waiting data. The master device then requests the waiting data in a second format. In one embodiment, the slave device notifies the master device of the slave device's available processing capabilities.

In one embodiment, the master device upgrades a software in a slave device by searching for an upgrade software in an external network and checking, for example, version information.

The master device, in one embodiment, comprises a first interface linked to the slave device, a first memory for storing operating software, application software and device configuration information for the master device, a second memory for storing data and a microprocessing for controlling the first interface, the first memory and the second memory. In one embodiment, the master device comprises a battery for providing power to the master device. In one embodiment, the master device comprises an operator interface. In one embodiment, the master device comprises a second interface for communicating with the external network.

The slave devices may be, for example, a pen phone, a watch phone, a wireless headset, or a miniature wireless display device.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood, and its numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings.

FIG. 1 shows communication links for Bluetooth Technology.

FIG. 2 shows a communication system including a subnet having internal links and a link to an external communication network, all in accordance with the present invention.

FIG. 3 shows one embodiment of a gateway device in accordance with the present invention.

FIG. 4 shows the functional parts of a communication device.

FIG. 5, which is comprised of FIGs. 5A and 5B arranged as illustrated in the key to FIG. 5, shows in flowchart of gateway communication process.

FIG. 6 is an embodiment of a gateway structure for a networked car.

FIG. 7 is an embodiment of a gateway structure for a networked house.

FIG. 8 is an embodiment of a gateway structure for a networked camera.

FIG. 9 is an embodiment of a gateway structure for music-on-demand.

FIG. 10. is an embodiment of a gateway structure for a restaurant guide.

FIG. 11 shows a pen phone wireless audio device.

FIG. 12 shows a watch phone wireless audio device.

FIG. 13 shows a wireless headset.

FIG. 14 shows a microdisplay.

The use of the same reference symbols in different drawings indicates similar or identical items.

DETAILED DESCRIPTION OF THE INVENTION

A system and a method of network access using a single device that serves as a gateway for various electronic devices are provided. In accordance with the present invention, functions of a communication device are broken apart and each function of the communication device is embodied in a device in a local network (i.e., a subnet) which includes a gateway device and at least one dependent/independent device (or slaves). The devices may physically reside in the same or separate units. The gateway device is the master for the subnet and has the intelligence to establish communication between the dependent/independent devices in the subnet and a peripheral system connected to an external network or between the dependent/independent devices themselves, by using a simple protocol. The external network is an established network.

FIG. 2 shows a communication system 200, including a subnet 201 and an external communication network 202. Subnet 201 is typically an unlicensed wireless link and consists various components making up a particular communication system, including a cellular/PCS phone. In general, subnet 201 is made up of a gateway device 203 and various dependent and independent devices linked together. In one embodiment, subnet 201 has low power, small footprint, 10-meter range and high data rates for at least 10 devices within the range.

Gateway device 203 acts as a master to all dependent/independent devices in subnet 201. Unlike Bluetooth where every device in the piconet may take on a role of either a

master or a slave, gateway device 203 is the exclusive master in the subnet and has a fixed role as the master of the subnet. A device having a fixed role of being a master and performing exclusive functions of a master has the advantage of less cost and complexity because the dependent/independent devices do not have to have the intelligence and sophistication of a master unit. In other words, the dependent/independent devices do not require the more expansive and complicated software and/or hardware to perform the more complicated functions of a master. Instead, the dependent/independent devices only requires a very simple communication interface to communicate with the fixed master. The dependent/independent devices are sometimes referred to as "slaves."

Gateway device 203 in one embodiment acts as a network gateway between external communication network 202 and the dependent/independent devices in subnet 201. Dependent devices 1 through M are devices that communicate most of their information to and from external communication network 202 via gateway device 203. For example, a display may need to receive display information from an external communication device and may not have functions on its own. Independent devices 1 through N, on the other hand, have substantial functionality when not communicating to gateway device 203 and their feature set is enhanced in the presence of a gateway device. For example, a television has substantial functionality of receiving and displaying the video and audio signals from a network outside of the gateway and in the presence of a gateway device, it may acts as a display unit for a computer.

In one embodiment, gateway device 203 acts as a gateway between various dependent/independent devices in a subnet. For example, a personal computer in the subnet may turn on a television, also in the subnet, via gateway device 203.

In the example where the communication device is a cellular phone, gateway device 203 may house the cellular RF circuitry, a battery and the wireless circuitry needed to communicate with all dependent/independent devices in subnet 201. The dependent/independent devices may include a stereo providing microphone and speaker functionality, a computer providing dialing function and a television providing a display function. The stereo, computer and television each fits in the independent device category because they have substantial functionality without any gateway devices.

FIG. 3 shows a gateway device in detail. In general, gateway device 203 consists of an external network interface 402 for communicating to an external network such as the internet, a voice network, another gateway device in a subnet, or a mobile unit; an internal network interface 404 for communicating to a dependent/independent device in a subnet residing a short distance from each other and from the gateway device, e.g., within 10 feet of each other; a microprocessor 406 for controlling all other units in gateway device 203; a flash/ROM (read-only memory) 408 for storing the operating system, device configuration information, user interface and their related application software; a RAM (random access memory) 410 for buffering a device list and message contents; and an optional operator interface 412 such as a display or a keyboard for displaying status or user input. Units in gateway device 203 generally depend on the feature set choices, hence is implementation oriented. For example, microprocessor 406 can be an 8-bit microprocessor and memory 408 is a size suitable to the selected feature set.

Application software, in one embodiment, gives the gateway device intelligence to decide where to route a particular message based on the type of the message received. Gateway device 203 may further include a battery (not shown) for providing power to the components making up gateway device 203.

In one embodiment, gateway device 203 has a design that looks like a pager (as shown in FIGs. 6 through 10). However, the actual gateway device 203 can be of any design, the design being typically dependent upon the required battery size and a convenient way for the user to travel with the gateway device. In general, there is no limitation in the shape or size of the gateway device packaging. Each of the dependent/independent device in the subnet has a transmitting and receiving circuit and related software to communicate with the gateway device. The communication path between the gateway device and the dependent/independent devices can be either wired or wireless.

Referring back to FIG. 2, in one embodiment, the communication between gateway device 203 and dependent devices 1 through M, e.g., links 2041 through 204M, and between gateway device 203 and independent devices 1 through N, e.g., links 2061 through 206N, is accomplished by any type of wireless links such as, but are not limited to, digital radio frequency (RF), analog RF or InfraRed. The communication between

gateway device 203 and the dependent/independent devices can also be accomplished by any wireless links that fall under any air interface (i.e., the standard operating system of a wireless network) such as AMPS (advanced mobile phone service), TDMA (time division multiple access), CDMA (code division multiple access) or GSM (global system for mobile communications). Other wireless technologies, such as Bluetooth technology, wireless IEEE 1394 or any other existing or unique protocol, can be used as well. Alternatively, the wireless links described above can be replaced with wired links, although wired links decrease portability.

Similarly, the dependent devices and the independent devices may communicate with each other wirelessly via gateway device 203. For example, dependent device 1 can communicate with independent device 1 via link 2041 (from dependent device 1 to gateway device 203) and link 2061 (from gateway device 203 to independent device 1).

Alternatively, dependent devices and independent devices may communicate directly with each other without gateway device 203. For example, dependent device 1 can communicate directly with another dependent device M via link 2101M; independent device 1 can communicate directly with another independent device N via link 2121N; and dependent device M can communicate directly with independent device N via link 208MN. These direct communication links are accomplished through either wired or wireless links. It is noted, however, that additional hardware/software may be needed for such direct connections.

The information transmitted between gateway device 203 and any of the dependent/independent devices in subnet 201 are made up of control information and payload data. The control information is for establishing the communication link between gateway device 203 and a dependent/independent device in subnet 201 and for negotiating device capability. Negotiating device capability is described in detail later with reference to FIG. 5. The payload data is any data that needs to be transferred to a device in the subnet and includes information such as, but not limited to, voice information, video information or text information. The payload data can be of any format.

The external communication network 202 is composed of wired or wireless communication devices and/or networks. For example, the devices/networks in external communication network 202 may be, but are not limited to, an internet 215, a voice

network 216, another subnet with a gateway device 217, or a mobile unit 218. The communication devices/networks in the external communication network 202 communicate with, for example, a cellular/PCS (personal communications services) base station or an internet service provider (ISP) 214 which is linked to gateway device 203 in subnet 201 via link 220. Again, link 220 may be either wired or wireless.

Gateway device 217 similarly has associated dependent and independent devices connected in a subnet (not shown). Therefore, a device in subnet 201 may communicate with a device in the other subnet via gateway device 203, cellular/PCS base station or ISP 214 and gateway device 217. For example, a user can initiate download of a song playing on a stereo in subnet 201 to a PC (personal computer) in the subnet where gateway device 217 is the master.

How gateway device 203 facilitates communication is discussed in detail later in reference to FIG. 5. In general, the gateway device facilitates communication by serving as the system master. By being a master, gateway device 203 is always aware of the number and type of devices that are within its range and capable of communication (e.g., powered on, physically linked) by registering each device's capabilities and storing this information in its memory. The gateway device then uses the type of each device to decide what type of data is routed to it. For example, video type of data is routed to a television, a computer screen or a LCD display but is not routed to an oven, a telephone or a radio. Routing is accomplished using a simple protocol which is discussed in detail below. Therefore, the gateway device has routing intelligence. It is noted that the gateway device is always the dedicated master and the only master, unlike Bluetooth where each device in the piconet can change its role from a slave to the master and vice versa.

FIG. 4 shows an application where a typical communication device such as a cellular/PCS phone is replaced with wirelessly networked units in a local network in accordance with the present invention. A typical cellular/PCS handset 310 has a transceiver 300, a user interface 304 and an audio/visual/data source 302 linked by various hard-wired communication paths, e.g., communication paths 301, 303 and 305. Transceiver 300 in one embodiment contains an RF transceiver, a battery and an antenna. User interface 304 may contain, for example, a keypad and a display. Audio/visual/data

source 302, in one embodiment, is a headset. Additional examples for the make up of a local network for a communication device are described below.

Transceiver 300 provides a communication path 301 from data source 302 to the outside world, e.g., an external network, over a communication medium 306. User interface 304 relates status of the data from data source 302 and communication medium 306. User interface 304 also allows the user to control the connectivity of communication medium 306 and communication information that is being transferred to/from transceiver 300 via communication path 305. Typically, communication paths 301, 303 and 305 are hardwired within a phone unit.

In accordance with the present invention, transceiver 300, user interface 304 and audio/visual/data source 302 in the above-described cellular/PCS phone 310 may be broken apart into separate units. For example, transceiver 300 can be placed in a cellular/PCS radio module; user interface 304 can be placed in a heads-up display; and audio/visual/data source 302 can be placed in a microphone located in a car stereo. The cellular/PCS radio module, the heads-up display and the stereo microphone in this example, are separate and independent units. The communication paths 301, 303 and 305, in one embodiment, are wired links as before. However, communication paths 301, 303 and 305, in one embodiment, are replaced by wireless links established using any conventional means described above.

Transceiver 300 acts as the gateway device between the external network and the dependent/independent devices, e.g., user interface 304 and audio/visual/data source 302. Gateway device, in addition to transceiver 300, may include, for example, a battery to provide power to the gateway device and circuitry for interfacing with an external network and dependent/independent devices in the subnet. User interface 304 and audio/visual/data source 302 are either independent or dependent devices, depending on their functionality. For example, if user interface 304 is a heads-up display, it is a dependent device because it has limited functionality without a gateway device. However, if user interface 304 is a television, it is an independent device because it has substantial functionality without any gateway devices.

In general, any combination of the devices mentioned above, e.g., transceiver 300, user interface 304 and audio/visual/data source 302, can be created to satisfy the

application. For example, transceiver 300, user interface 304 and data source 302 can be placed in a single communication unit; transceiver 300, user interface 304 and data source 302 can be in their respective units; transceiver 300 can be in one unit and user interface 304 and data source 302 can be in another unit; user interface 304 can be in one unit and transceiver 300 and data source 302 can be in another unit; and data source 302 can be in one unit and transceiver 300 and user interface 304 can be in another unit.

FIG. 5 shows the flow of events after a gateway device has been established on a network and a device starts communicating with the gateway device. The process starts in step 500. The gateway device periodically sends a synchronization message to the dependent/independent devices in the subnet through the gateway device's control channel (step 502) to see if any new devices are in the subnet. If a new device is, for example, within range and capable of communication, e.g., powered on (step 503), the dependent/independent device synchronizes to the gateway device (step 504) and registers the dependent/independent device's capabilities with the gateway device (step 506). To register, the dependent/independent device sends a device capability word indicating the dependent/independent device's capability. The capability word contains capability bits representing various capabilities such as video capable, stereo capable, etc. For example, if a device is stereo capable, the stereo capability bit is set to a "one;" if the device is audio capable, the audio capability bit is set to a "one;" if the device is video and stereo capable, both video and stereo capability bits are set to "one." In one embodiment, the device capability word contains other information, such as format of the data, resolution of the display, etc. In one embodiment, the device capability word indicates to the gateway device the dependent/independent device's presence in the subnet. In one embodiment, the device capability word is 32 bits long. Of course, the device capability word can be of any length, depending on the amount and the detail of information desired for each dependent/independent device.

The gateway device receives the device capability word from the device notifying its presence. The gateway device then assigns the dependent/independent device a device identification number (device ID) and stores the device capability word and the corresponding identification number (step 507). In one embodiment, the device ID is eight bits long, which gives a number 0 to 255. In this embodiment, a maximum of 256

dependent/independent devices can be networked in a subnet. The maximum number of dependent/independent devices in a subnet is predetermined to allow a sufficient number of devices to be networked together, yet does not create an over-crowded network. This is opposed to the Bluetooth technology where the maximum number of devices in a piconet is eight.

If the number of registering devices exceeds the predetermined maximum allowable number, no new device will be registered until a registered device is taken off the device list. In one embodiment, the maximum allowable number is 256. In one embodiment, when a device ID becomes available, the gateway device reassigns the unused device ID number to the next registering device. In one embodiment, the gateway device assigns the device ID consecutively. For example, the first registering device is assigned a device ID of one; the second registering device is assigned a device ID of two; and so on. In one embodiment, the gateway device assigns a registering device the first available device ID. For example, device IDs 1, 2, 4, 5, 6, 8 are in use, the next registering device will be assigned a device ID of 3.

A device ID becomes available, for example, when a registered device is disconnected, goes out of range or powered off. In one embodiment, a registered device sends a predetermined "powerdown" message notifying the gateway device that it is powering off. For example, when a device is to be turned off by, e.g., pushing a power button, a signal is generated to signal software to do a clean shut down. In one embodiment, signal quality is monitored. A signal quality below an acceptable level and a bit error rate increase above a predetermined rate indicate the device is going out of range.

In one embodiment, the gateway device continuously polls the registered devices to update network connections. In one embodiment, the gateway device continuously sends a synchronization message at a predetermined time interval to register any added devices and de-register disabled devices. Therefore, the device list is continuously updated. By continuously updating the device list, the system becomes more efficient because the master unit will avoid sending messages to a disabled or inoperable device.

In one embodiment, the gateway device maintains an address table which is filled with zeroes initially to indicate that no device is registered with the gateway device. When a device registers with the gateway device, the gateway device looks for the first zero in the

table and assigns the device to that address. The gateway device then sets the address to a "one." In one embodiment, a disconnecting device sends a signal to the gateway device to reset the address back to a zero.

The above embodiment requires at least two tables to match the address with the capability words. Specifically, one table is needed to assign the address to a certain device and another table is needed to match the address to a capability word. In an alternative embodiment, capability words are stored in the address table. In this embodiment, if all bits of the capability words are zero, the address is not used. However, if not all bit are zero, the address is in use. Only one table is needed to match the capability word to the address. In general, any appropriate method can be used to assign device IDs.

In one embodiment, a group ID is assigned to a group of dependent/independent devices having substantially the same capabilities. The gateway device can then broadcast a message to multiple devices. For example, a television, a computer screen and a palm top are all video capable and thus can be assigned to a common group ID. A dependent/independent device with a device ID and a group ID will ignore messages that are not broadcast messages and are not addressed to it or its group. The dependent/independent device will only respond to messages that are broadcast messages or are addressed to it or to its group. For example, if a message is addressed to a video capable group, the television and the computer monitor will respond but not the stereo.

After the gateway device assigns the device ID and/or the group ID, the gateway device stores the device ID and the device capability word in a memory at the gateway device (step 507). In the alternative, the device list, including the device ID and the corresponding device capability word are pre-programmed into a memory instead of generated by the polling process described above.

The gateway device, now knowing the capability of each dependent/independent device in the subnet, queries the external network through the network control channel to check for any waiting data (step 508). The network control channel also checks for waiting data when no new device is in the subnet in response to the synchronization message (step 503). The query is sent to, for example, an internet server. The server receives the query from the gateway device and looks for waiting data (step 512). If there is waiting data (step 513), the server notifies the gateway device of the waiting data through the network

control channel (step 514). The notification message includes information indicating the type waiting data. For example, the waiting data may be in HTML format, text or graphics.

The gateway device receives the notification message from the server and checks its device list to see if any device is capable of processing the waiting data. If one or more dependent/independent devices are capable of processing the data, the gateway device informs the appropriate dependent/independent device of the waiting data (step 518). In one embodiment, when multiple dependent/independent devices have similar or the same capability, the gateway device will select a device to process the waiting data and send the notification message to that particular dependent/independent device. The gateway device may select the device based on, for example, efficiency. For instance, if a video image of 32-bit resolution is waiting to be directed and there is a computer screen with a 32-bit resolution and a palm top with an 8-bit resolution in the subnet, the gateway device will direct the image to the computer screen. In another embodiment, all the dependent/independent devices that are capable of processing the waiting data are notified. In this embodiment, a 32-bit image is sent to all video capable devices, e.g., both the computer screen and the palm top.

An example is used to illustrate the routing function of a gateway device. When an MPEG-4 (Motion Pictures Experts Group standard which support two-way video traffic, lower bandwidth lines and user interactivity that allows one to select parts of a program and ignore others) capable device connects to the network, the gateway device is responsible for finding the proper MPEG-4 connection on the external network side and routing MPEG-4 data whenever possible. Similarly, if the device has the capability to browse web pages, the gateway device requests the type of pages the device is capable of, e.g., HTML (Hypertext Markup Language), HDML (Hand-Held Device Markup Language), DHTML (Dynamic HTML), or text only. The type of pages can also be one that runs Java (Java is a portable object-oriented language which is compiled into byte codes), ActiveX (ActiveX provides a framework for dynamically extending capabilities of Web clients (browsers) as well as Web servers), or any of the common browser plugins.

In one embodiment, if no device is available or capable to process the waiting data, the gateway device waits.

The dependent/independent device or devices receive the notification of waiting data from the gateway device. The dependent/independent device then sends an acknowledgment to the gateway device through the control channel to inform the gateway device that it is ready for downloading (step 522). This handshake is to ensure that the device is ready to receive the waiting data. If the dependent/independent device is not ready, has been disconnected, powered off or gone out of range, the gateway device will not receive such acknowledgment from that dependent/independent device. In the embodiment where only one dependent/independent device is notified, the gateway device waits for a predetermined time delay, then searches its device list to select another dependent/independent device capable of processing the waiting data and repeats the process. In the embodiment where multiple dependent/independent devices are notified, the gateway device waits for a predetermined time delay, then sends the waiting data to all the dependent/independent devices that returned an acknowledgment.

In one embodiment, the user may select the dependent/independent device that he wants to use for the download. In one embodiment, a list of all dependent/independent devices having capability of processing the waiting data is displayed, for example, on a computer screen or a television screen. The user then selects a dependent/independent device from, for example, a keyboard or a remote control. The gateway device then notifies the selected dependent/independent device of waiting data. If the selected dependent/independent device is ready for downloading, it sends an acknowledgment back to the gateway device as described above. The gateway device, having received the acknowledgment from the selected device, downloads the waiting data to the selected device. In one embodiment, the user may select multiple dependent/independent device for the download.

In one embodiment, where all registered devices having capability for processing the data are notified, a list of acknowledging devices is displayed. The user then selects from the list of devices that are ready for download. The gateway device then sends the waiting data to the selected device. In one embodiment, multiple dependent/independent devices may be selected.

When one or more devices respond with an acknowledgment message, the gateway device requests download from the external network through its network control channel

(step 524). In one embodiment, where the data can be downloaded in various format compatible with the dependent/independent device, the server selects the download site based upon the best format the dependent/independent device is capable of processing. For example, if the waiting data is video data, a computer with a full screen is capable of processing full resolution, thus, the format downloaded is in full data format. However, if the device is a PDA which has a lower resolution, a data format with narrower bandwidth is requested. If only one format is available, data in that format is downloaded.

The server receives the data request from the gateway device, retrieves the data from the external network and sends data in the appropriate format to the gateway device through the network data channel (step 528). The gateway device routes the data to the appropriate device(s) that are ready for the download through the data channel (step 530

The dependent/independent devices receive and then process the received data (step 532). The process continues in step 534 where a decision of whether a network request from a registered device is made. The gateway then process the request step 536. The request can be, for example, a request for a different display resolution. In one embodiment, the server may restore a stored resolution. In one embodiment, the server may modify, e.g., reduce the resolution, based on the request. The process returns to step 502.

If there is no waiting data (step 513), step 534 is executed.

In one embodiment, the gateway device is capable of locating the appropriate software upgrade for any device in the subnet. For example, the gateway device may look for upgrades for the devices that are registered, the device may periodically detect an incompatibility and notify the gateway device, or the user may request an upgrade such as from a peripheral manufacturers website. The gateway device is then responsible to locate the upgrade in the network and then gets the upgrade from the network to the device. In general, the initiation of the upgrade is application software dependent. In one embodiment, the user prompts the system to look for an upgrade. This is because the user may have to pay for access to the external network on a minute by minute basis and should be afford the opportunity to decide when and how often the upgrade is performed. Typically, incompatibility is detected by comparing the version number of the application software, similar to PC application software version detection.

The protocol used for gateway communication is now described. In general, the goal of a routing algorithm is to be simple, fast, easy to implement, robust - that is, to make few errors while sending a data packet to its next destination, and resilient to network changes. In one embodiment, the protocol is packetized to allow multiple devices to communicate at once. The air (wireless) protocol can use a Time-Division Multiple Access (TDMA) structure, assigning time slots to devices to prevent collisions. A Code Division Multiple Access (CDMA) structure can also be employed to give better performance, but typically at a higher processing and materials cost. In one embodiment, each data path has an associated priority so that high priority data is transferred faster. In this embodiment, the gateway device is responsible for holding off a lower priority data stream to preference a higher priority data stream. In another embodiment, data security provisions are provided to take into consideration of another user's device, e.g., another gateway device, within the range of a gateway device. In one embodiment, error detection is employed to insure the robustness of the link. In another embodiment, error correction is employed to further insure the robustness of the link.

In accordance with the present invention, the communication between any device and the gateway device follows a simple protocol. In one embodiment, the command set includes the following example of commands and command categories, shown in TABLE I,. It is noted, however, that different commands and command categories may be used.

TABLE I

Category	Command	Function
Connection	Register	Registers a dependent/independent device with the gateway device; assigns a device ID to each registering dependent/independent device; stores device capability and corresponding device ID in a memory at the gateway device.
	Open_Path	Creates a dedicated communication path, e.g., voice, data, or image, for a real time connection. The command Open_Path includes a phone number as the

		destination if the sender is a call origination.
	Close_Path	Closes a communication path that was opened with the command Open_Path.
Status	Display	Displays various status, such as battery level, cellular RSSI (received signal strength indication), message waiting, etc.
	Status	Requests items that are used in the Display command plus connecting status
Data	Receive	Requests data from the external network or a dependent/independent device.
	Transmit	Sends data to the external network or a dependent/independent device.
	Message	Alerts the user of a waiting message.
Memory	Write	Writes stored parameter, including configuration, address book, and image.
	Read	Reads back any stored parameter.
Upgrade	Upgrade	Requests an upgrade from the external network or instructs a dependent/independent device to update with the file that follows the command.

It is noted that a simple command set keeps the interface simple between the gateway device and the dependent/independent devices. There are no internet-protocol specific commands in Table I for, e.g., checking E-Mail, doing FTP (File Transfer Protocol) or HTML (Hypertext Markup Language), or UDP (User Datagram Protocol) because these commands are handled by the gateway device, not by the individual dependent/independent devices on the network. Instead, a dependent/independent device simply sees in the Display command, for example, that E-Mail is waiting. The dependent/independent device then optionally requests the waiting E-Mail with a Receive command. The E-Mail message is then read from the external network and transmitted from the gateway device with a Transmit command that has the E-Mail message as its data.

Therefore, although the gateway device handles the difficult task of connecting the dependent/independent device to the external network or another dependent/independent device that is compatible with the dependent/independent device, the protocol between the dependent/independent device and the gateway device is simple enough to keep the dependent/independent device simple, small, and inexpensive, yet powerful enough to provide user satisfaction.

The following examples illustrate specific applications using a gateway device.

The first example is a networked car shown in FIG. 6. While a user is driving along and listening to car stereo 606, the gateway phone 602 in a briefcase in the back seat receives an incoming call. Gateway phone 602 sends a signal to mute car stereo 606 and sends a signal to display a message "CALL" at a heads-up display 604. After pressing the "ANSWER" button on car stereo 606 acknowledging that it is ready to download data, the user has a hands free conversation with the calling party, using the microphone anywhere in the car, such as car stereo 606. In this example, the subnet consists of gateway phone 602, car stereo 606 and heads-up display 604, with gateway phone 602 being the gateway device, car stereo 606 being an independent device and heads-up display 604 being a dependent device. Gateway phone 602 communicates with a cellular/PCS base 608 and routes the phone message to car stereo 606 and heads-up display 604 on the subnet.

The calling party asks the receiving party to meet him in a restaurant that the receiving party has never been to. After hanging up, the receiving party presses the "VOICE RECOGNITION" button on car stereo 606 and says "DIRECTIONS" and the name of the restaurant. The driving direction appears in heads-up display 604 in text format. Heads-up display 604 points out the next turn to take and an arrow follows the turn in a field of view through the windshield. In this scenario, gateway phone 602 is the gateway device communicating to an ISP 610 to retrieve direction 612 from the internet. Gateway phone 602 then routes the direction information to heads-up display 604.

Another example is a networked house shown in FIG. 7. While watching television 702 with audio through a user's home stereo 704, the user's gateway phone 706 on his belt receives a call from a caller via cellular PCS base 710. The gateway phone 706 sends a signal to mute the user's stereo 704 and sends a signal to display "INCOMING CALL" and the caller ID information on the user's television screen 702.

Caller ID provides information about the calling party. The caller ID service is typically available to telephone subscribers for a small additional monthly fee. Under current wireline standards, frequency-encoded digital caller ID information is transmitted between the first and second ring signals. Information about a calling party is thus received, stored, and displayed by a caller ID device before a user would normally answer a ringing telephone. Caller ID information is typically recorded by caller ID devices whether the associated telephone is answered or not. Typically, a conventional caller ID device is within a phone unit or connected to a phone via a wired link. The caller ID device usually receives, stores and displays digital caller ID information.

In accordance with the present invention, the gateway device receives and stores the caller ID information in a memory at the gateway device and transmits it wirelessly to television 702 for display. Thus, there is no need for a dedicated caller ID device or adding additional hardware to the phone itself. In one embodiment, the gateway device stores a video or audio image associated with a directory match ID with the incoming call. Such video image may be a digital picture, clip art file, wave (e.g., *.wav) or a *.mp3 file for audio imaging. In another embodiment, the display device stores the caller ID information.

The user then hits the "PHONE" button on a remote control device 708 to answer the call. Gateway phone 706 receives the answer signal from remote control device 708 and negotiates the video format of the call with the cellular PCS base 710 so that the video format is compatible with television 702. If data format is compatible with television 702, the image of the caller is displayed in a picture-in-picture (PIP) window (or full screen, if the television is not capable of PIP.) In one embodiment, the voice conversation comes through stereo 704 and uses the microphone in remote control device 708. If the incoming call is not a video call, no video is displayed. If the caller sends his location, a map pops up on television 702, with the location of the caller highlighted. If the user gets up and leave the room, the hands-free conversation is continued on the next closest stereo, television, or personal computer.

In the above example, the subnet first includes gateway phone 706, television 702 and stereo 704 in the living room. When the user leaves the living room, i.e., the gateway device moves, television 702 and stereo 704 may go out of range and drop out of the subnet. However, when the user walks into another room, e.g., the bedroom, another

television or stereo or personal computer may come into range and register with gateway phone 706, forming a new subnet. Gateway phone 706 which was routing video data to television 702 in the living room may now route the video data to a computer in the bedroom.

In the home networking environment, the gateway principles can be applied to create a very simple wireless network between home entertainment devices, appliances, security systems, and other electronics and to create a gateway device for all of these devices to access an external network over a cable, phone, or antenna.

The next example is a photographer who carries a cellular/PCS phone that works as a gateway device as shown in FIG. 8. After receiving a voice call on his cellular/PCS phone 804 to alert him of an event, the photographer can send pictures from his digital camera 802 wirelessly through his gateway phone 804 to a destination 806 on the internet. The camera simply sends the data, while the gateway phone 804 does the internet negotiations over the cellular/PCS system 808 to place the photo where it should go. In this example, gateway phone 804 is the gateway device and digital camera 802 is an independent device on the subnet. If digital camera 802 is within range of the photographer's PC 806, the photos can be sent to PC 806 using the same protocol, and PC 806 can act as the gateway device. The development cost of a combined cellular/PCS camera would be much higher than the separate units, so developing separate units, i.e. peripheral devices, is not only less costly, but also allows piece by piece upgrades.

Another example is music-on-demand shown in FIG. 9. While listening to music on a mini-disc or portable music player 902, the user can preview the latest music release from a source 906 on the internet via ISP 908, and purchase the music release with the touch of a button on mini-disc or portable music player 902. After purchase, the song is downloaded from source 906 to gateway device 904 which negotiates and routes the song to mini-disc or portable music player 902. The mini-disc can be replaced with, for example, a small flash-card or flash box that holds music and replays it on demand.

An additional example is a restaurant guide shown in FIG. 10. A PDA 1002 can get location information from a gateway device 1004 (from the CDMA infrastructure) and request entertainment information for the area from existing HTML systems. Gateway device 1004 routes the data from the selected web site 1006 to PDA 1002 for formatting.

This approach allows PDAs the benefit of connectivity while keeping the size small and the design simple.

To satisfy user demand of smaller cellular phones, a phone is split into smaller pieces to give the user the perception of a smaller phone. Putting the large battery, RF and call processing circuitry off on a belt or in a purse and leaving a small audio device in the user's hand gives the perception of a very small phone. The difficulty in splitting the phone into smaller pieces is that the user must be able to control the phone from this small device so the phone itself never leaves the belt or the purse.

Applying gateway architecture to the cellular/PCS phone environment has some immediate benefits to the end user. For example, the biggest change to the user is that the large RF circuitry and associated battery (e.g., the gateway device) can be in a remote location, even during a phone conversation. The user interface could be in a tiny device the size of a credit card. The audio can be carried to/from the user through a very small headset. The user may rely on the headset with voice recognition for dialing, and may never see the gateway device during the course of the day. The user will perceive the cellular phone as being a very small, manageable device. Furthermore, the cellular/PCS phone provides high-speed connection and can be used in applications that benefit every target consumer. The consumers can "mix-and-match" their internet-ready equipment, purchasing only the items that they need. The gateway device also gives basic devices (wrist watch, refrigerator, alarm clock) an added dimension of connectivity without significantly increasing product cost.

In addition, the gateway architecture benefits the manufacturers as well. To cover all possibilities in the market, a manufacturer would need to create an array of products that are all cellular/PCS compatible, or make the cellular/PCS phone modular so that it can be connected to one device at a time. However, by allowing the cellular/PCS phone to act as a gateway device for all peripheral devices that can talk to it by adding a simple, low power, wireless interface to the gateway device for each peripheral device, a device could be made "internet-ready" for a cost much less than by adding full power cellular circuitry for each peripheral device.

Since the gateway concept can be applied to a wide variety of devices on any kind of network, the alternate uses have a very wide range. The principles can be applied

wherever device cost can be lowered and size can be reduced by moving high-power complex communication circuitry off a common device.

Some implementations of the dependent/independent device are now described. The first implementation is a pen phone wireless audio device shown in FIG. 11. The pen phone wireless audio device 1100 is in the shape and size of a pen and has functionality of a pen. In addition, pen phone wireless audio device 1100 has added functionality of a telephone. In one embodiment, the cellular/PCS communication circuitry, e.g., the transceiver, is placed in a gateway device. The pen phone wireless audio device provides a user interface device that is separate from the transceiver. The pen phone wireless audio device acts as a dependent device of the gateway device because its functionality is limited without a gateway device to route audio or process voice commands.

The pen phone wireless audio device 1100 incorporates for example, a microphone at the bottom 1102 and a speaker at the top 1104 of pen phone wireless audio device 1100. The microphone is electrically coupled to a transmitting circuit while the speaker is electrically coupled to a receiving circuit. The transmitting circuit and the receiving circuit communicate with a gateway device having a transceiver via wireless communication paths. The user may, for example, have a two-way conversation by holding the pen phone wireless audio device up to the side of his face, aligning the top of the pen phone wireless audio device with his ear and the bottom of pen phone wireless audio device 1100 near the mouth.

For an incoming call, pen phone wireless audio device 1100, upon reception of a radio signal, informs the user of signal reception by a ring indication. In one embodiment, the ring indication is audible. In another embodiment, ring indication is vibration. Both ring indications can be accomplished by conventional hardware and software. For example, audio sound can be implemented by any suitable piezo electric transducer and internal vibration can be implemented by any suitable rotating counter weight. To initiate a call, dialing in one embodiment, is accomplished either with voice recognition (with VR processing in the gateway device) or a modification of Jogdial Navigator™ dialing system manufactured by Sony Electronics Inc.

In one embodiment, a voice recognition apparatus as that described in U.S. Patent No. 5,335,261 entitled "Radio Telephone Apparatus" by Fujinaka, Akihiko, and assigned

to Sony Corporation, hereby incorporated by reference in its entirety, is used. The voice recognition apparatus includes a microphone device for sensing the initiating voice and a voice recognition circuit for recognizing a voice input to the microphone and for performing a dialing operation based on the voice. Optionally, the voice recognition apparatus further includes a mute switch which enables/disables the voice recognition circuit. Typically, when set to the voice recognition mode following the off-hook operation, the radio telephone apparatus is in a state of waiting for entry of the destination-identifying voice, that is, in the state in which the voice inputted to a microphone device may be transmitted as electrical signals to the voice recognition circuit. When the destination-identifying voice is inputted to the microphone device, the voice recognition circuit proceeds to identify the destination by associating the information corresponding to the electrical signals transmitted from the microphone device with destination-related information stored in the memory. The voice recognition circuit then proceeds to control the transmitting circuit etc. of the radio telephone apparatus for effectuating the transmitting operation. Alternatively, any known voice recognition and auto-dial may be used.

The jog-dial dialing system as described in U.S. Patent No. 5,905,964, entitled "Portable Communication Apparatus" by Sudo, Fukuharu, issued on May 18, 1999, and assigned to Sony Corporation, is hereby incorporated by reference in its entirely. In one embodiment, the jog-dial dialing system described in the '964 patent which has an up, down and click input is modified for the present application in that the up/down is translated into rotation of the pen body 1106, and the click is a button on top 1108 of the pen. This combination is then used to scroll through selections that are shown on, e.g., a liquid crystal display 1110 comprising a matrix of pixels, and to choose the desired telephone number with a click. New numbers can be entered by the spin-and-click method, or dialed using voice recognition. The pen phone wireless audio device 1100 retains the writing functionality of a pen.

The next implementation of the dependent/independent device is a watch phone wireless audio device shown in FIG. 12. Watch phone wireless audio device 1200 is an implementation of a user interface device that is separated from the transceiver, which is the gateway device in this example. Watch phone wireless audio device 1200 incorporates

a microphone, speaker, and limited user interface, similar to the pen phone wireless audio device described above. Watch phone wireless audio device 1200 also fits into the dependent category of gateway devices, since its functionality is limited without a gateway device to route audio or process voice command.

Watch phone wireless audio device 1200 incorporates a microphone electrically coupled to a transmitting circuit and a speaker electrically coupled to a receiving circuit. The transmitting circuit and the receiving circuit communicate with a gateway device via wireless communication paths.

In one embodiment, watch phone wireless audio device 1200 with a display 1202 allows a two-way conversation, for example, by using the watch phone wireless audio device 1200 as a speakerphone. In one embodiment, the conversations take place at arm's length. In other words, both the microphone and the speaker are embedded in the device. In another embodiment, wristband 1204 has a speaker that flips out to sit in the palm of the hand with a microphone (not shown) attached to wristband 1204, allowing a conversation when the palm is cupped over the ear. The speaker and the microphone may be any suitable speakers and microphones. Alternatively, a speaker wire (not shown) may run up the user's arm and into the ear of the speaker to give more private conversation. In another embodiment, both the ear plug and the microphone use wire connections.

The gateway device, in one embodiment, is controlled with voice commands as that described in the '261 patent. In one embodiment, the gateway device is a keypad (not shown) that includes multiple pressure-activated switches for user input. In the alternative, a jog-dial 1206 may be added to give a user interface similar to that described in the '964 patent. Another embodiment incorporates a suitable touch screen with handwriting recognition.

A third example of a dependent/independent device is a wireless headset 1301 with hookswitch control and call alert shown in FIG. 13. In one embodiment, the headset has a normal functionality of receiving and transmitting radio signals. In addition, the headset performs functionality such as incoming call indication, caller ID information (e.g., LED display, LCD display), hookswitch control, volume control and battery indication (e.g., LED display, beeper). The headset incorporates a microphone electrically coupled to a transmitting circuit and a speaker electrically coupled to a receiving circuit. The

transmitting circuit and the receiving circuit communicate with a gateway device via wireless communication paths. When an incoming call is received by a gateway device, the gateway device mutes, e.g., the stereo the headset is connected to, and activates an incoming call indication in the form of, for example, a beep or a ring to alert the user of an incoming call.

Hookswitch control operates such that when the hookswitch is open, all parts of the telephone are disconnected from the telephone line except a ringer circuit. When a calling party places a telephone call to a receiving party, switching equipment in the central office notifies the receiving party's telephone to alert the receiving party to an incoming telephone call. When the receiving party lifts the handset from its cradle to answer the incoming telephone call, the hookswitch closes, and the connection between the calling party and the receiving party.

In one embodiment, the headset, combined with voice recognition for dialing and feature control, gives the user enough control to never touch the actual phone in normal operation. In one embodiment, the headset can be folded in half when not in use. In one embodiment, the headphone can fold and unfold for hookswitch control. In one embodiment, the microphone is separated from the headset to allow attachment to a lapel or sun visor in a vehicle.

The fourth implementation of a dependent/independent device is a miniature wireless display device 1401 shown in FIG. 14 along with a U.S. 5-cent coin to illustrate the relative size of device 1401. Miniature wireless display devices are displays that use a silicon chip as the substrate material. The chip also houses the addressing electronics (at least an active matrix with integrated drivers), usually implemented in standard CMOS technology. This mature technology generates very reliable and stable circuits and allows very small pixel pitches (<10 um) and high display resolutions. Microdisplays are small and can be used in projectors, head-mounted displays, view-finders or other lens-view display systems. Different electro-optical effects can be used to generate the image: Electroluminescence (EL), vacuum fluorescence (VF), reflective Liquid Crystal effects and tilting or deforming of micromirrors (requires micro-machining). The most popular combination is Liquid Crystal on Silicon (LCOS) which provides a virtual SVGA 15" monitor at a distance of greater than 2 feet when viewed through the viewfinder. The

actual display itself may measure only one quarter inch on a diagonal. Navigation keys are located on the device to interact with the software that is controlling the displayed image from the gateway device.

The virtual display fits into the gateway concept in that the information that is shown is either generated by the gateway device or routed by the gateway device to the display from a source on the infrastructure. The display can be used for picture/video review or web browsing. Because it is small and wireless, it can be attached to a keychain or a retractable tether.

Although the invention has been described with reference to particular embodiments, the description is only an example of the invention's application and should not be taken as a limitation. Various other adaptations and combinations of features of the embodiments disclosed are within the scope of the invention as defined by the following claims.

CLAIMS

We claim:

1. A method for communicating between a device and a slave, comprising:

establishing a subnet, comprising:

providing a dedicated master device;

providing said slave device;

linking said slave device to said master device with a first communication path; and

communicating a message from a device to said slave device through said master device.

2. The method of Claim 1, wherein said master device routes a message to said slave device in accordance to its capability.

3. The method of Claim 1, further comprising:

sending a synchronization message to said slave device from said master device; and

registering said slave device with said master device.

4. The method of Claim 3, wherein said registering comprises providing to said master device information defining capabilities of said slave device.

5. The method of Claim 4, wherein said information comprises a device capability word having a plurality of capability bits indicating device capabilities.

6. The method of Claim 5, wherein said capability word includes a data format.

7. The method of Claim 5, wherein said capability word includes display resolution.

8. The method of Claim 1, wherein said second device is in an external network, further comprising linking said master device to said second device with a second communication path.

9. The method of Claim 8, further comprising said master device querying said external network for waiting data.

10. The method of Claim 9, further comprising said external network checking for waiting data.

11. The method of Claim 10, further comprising said external network notifying said master device of waiting data.

12. The method of Claim 11, wherein said notifying comprises said external network sending a notification word to said master device, said notification word comprising message type.

13. The method of Claim 12, further comprising said master device determining whether said slave device is capable of processing said waiting data.

14. The method of Claim 13, further comprising said master device notifying said slave device if said slave device is capable of processing said waiting data.

15. The method of Claim 14, further comprising said slave device acknowledging said master device when said slave device is ready for a download.

16. The method of Claim 15, further comprising said master device requesting a download from said external network.

17. The method of Claim 16, further comprising downloading said waiting data from said external network to said slave device through said master device.

18. The method of Claim 17, wherein said master device selects a format of said waiting data as a function of processing capabilities of said slave device.

19. The method of Claim 17, further comprising said slave device notifying said master device if said slave device cannot process said waiting data.

20. The method of Claim 19, wherein said waiting data has a first format, further comprising said master device requesting said external network to send said waiting data in a second format, different from said first format.

21. The method of Claim 19, further comprising said master device informing said external network of available processing capabilities of said slave device.

22. The method of Claim 1, wherein said device is a second slave device, further comprising linking said second slave device to said master device.

23. The method of Claim 22, wherein said second slave device has a capability word, further comprising:

assigning a device identification number to said second slave device; and

storing said capability word and said device identification number in a device list in a memory in said master device.

24. The method of Claim 23, wherein said assigning a device identification number comprises said master device assigning a device identification number when the number of registered slave devices is less than a predetermined maximum allowable number.

25. The method of Claim 23, wherein said assigning comprises said master device setting an address in an address table in said memory.

26. The method of Claim 25, further comprising said master device resetting an address in said address table when a corresponding slave device is disconnected from said subnet.

27. The method of Claim 23, further comprising said master device checking said device list for slave devices capable of processing waiting data.

28. The method of Claim 27, further comprising:

said master device selecting a slave device as a function of the processing capabilities of said slave devices; and

said master device notifying said selected slave device of said waiting data.

29. The method of Claim 28, further comprising said master device waiting for a predetermined time for an acknowledgment from said notified slave device.

30. The method of Claim 29, wherein said master device does not receive said acknowledgment, further comprising selecting from said device list a second slave device capable of processing said waiting data.

31. The method of Claim 27, further comprising said master device notifying all slave devices capable of processing said waiting data.

32. The method of Claim 31, further comprising said master device waiting for a predetermined time for acknowledgments from said notified slave devices.

33. The method of Claim 32, further comprising said master device broadcasting said waiting data to all notified slave devices that sent an acknowledgment.

34. The method of Claim 27, further comprising a user selecting a slave device for downloading.

35. The method of Claim 34, wherein said selecting comprises selecting from a list of all slave devices capable of processing said waiting data.

36. The method of Claim 35, further comprising said master device notifying said selected slave device of said waiting data.

37. The method of Claim 36, further comprising:

said master device waiting for a predetermined time period for an acknowledgment from said selected slave device; and

downloading said waiting data from said external network to said selected slave device through said master device if said selected slave device returns an acknowledgment to said master device.

38. The method of Claim 34, further comprising:

said master device notifying all slave devices capable of processing said waiting data;

said master device waiting for a predetermined time for acknowledgments from said notified slave devices;

said user selecting from a list of slave devices that sent an acknowledgment to said master device; and

said master device notifying said selected slave device of said waiting data.

39. The method of Claim 38, further comprising downloading said waiting data from said external network to said selected slave device through said master device.

40. The method of Claim 23, further comprising:

said master device sending a synchronization message to said slave devices at a predetermined time intervals; and

said master device updating said device list.

41. The method of Claim 40, wherein said updating comprises deleting slave devices that are selected from the group consisting of disconnected devices, powered off devices and devices that are out of range of said master device.

42. The method of Claim 22, wherein said subnet comprises a plurality of slave devices, further comprising assigning a group identification number to a group of slave devices in said subnet.

43. The method of Claim 42, wherein said group is a subset of said plurality of slave devices.

44. The method of Claim 42, wherein said group of slave devices have substantially the same device capabilities.

45. The method of Claim 22, wherein each of said plurality of slave devices has a capability word, further comprising:

assigning a device identification number to each of said plurality of slave devices; and

programming a device list in a memory in said master device, said device list comprising said device capability words and said device identification numbers.

46. The method of Claim 22, further comprising sending a message from said slave device to said second slave device, comprising:

said slave device notifying said master device of said message;

said master device determining whether said second slave device is capable of processing said message;

said master device notifying said second slave device of said message if said second slave device is capable of processing said message;

said second slave device acknowledging said master device when said second slave device is ready for download; and

downloading said message from said slave device and storing said message in a memory at said master device; and

downloading said message from said master device to said second slave device.

47. The method of Claim 22, further comprising preparing for transmission a message from said slave device to said second slave device, comprising:

said slave device notifying said master device of said message;

said master device determining whether said second slave device is capable of processing said message;

said master device notifying said slave device if said second slave device is incapable of processing said message.

48. The method of Claim 47, further comprising said master device notifying said slave device of the device capabilities of said second slave device.

49. The method of Claim 1, further comprising said master device upgrading a software in said slave device.

50. The method of Claim 49, wherein said upgrading comprises searching for an upgrade software in an external network.

51. The method of Claim 1, wherein said linking said slave device to said master device comprises wirelessly linking said slave device to said master device.

52. A communication system, comprising:

a subnet comprising:

a dedicated master device performing an exclusive master function of a first device;

a slave device performing a function of said first device; and

a communication path linking said master device and said slave device; and

a second device coupled to said subnet wherein said second device communicates to said slave device through said master device.

53. The communication system of Claim 52, wherein said first device is a cellular phone and said master device is a transceiver.

54. The system of Claim 52, wherein said master device comprises:

a first interface linked to said slave device;

a first memory for storing operating software, application software and device configuration information for said master device;

a second memory for storing data; and

a microprocessor, said microprocessor controlling said first interface, said first memory and said second memory.

55. The system of Claim 54, wherein said first interface comprises:

a transceiver for transmitting and receiving data from said slave device; and

a circuitry for wireless communication between said master device and said slave device.

56. The system of Claim 54, wherein said first memory stores a device list.

57. The system of Claim 56, wherein said device list comprises a capability word and a device identification number of said slave device.

58. The system of Claim 57, wherein said subnet comprises a plurality of slave devices, said device list comprising a capability word and a device identification number for each of said plurality of slave devices.

59. The system of Claim 54, wherein said data stored in said second memory comprises a device list, said device list comprising device capability word and device identification number for said slave device.

60. The system of Claim 59, wherein said device capability word comprises a plurality of capability bits selected from the group consisting of a stereo capable bit, an audio capable bit and a video capable bit.

61. The system of Claim 59, wherein said device capability word comprises data format information.

62. The system of Claim 59, wherein said device capability word comprises display resolution information.

63. The system of Claim 59, wherein said subnet comprises a plurality of slave devices, said device list further comprises a group identification number for a group of slave devices in said subnet.

64. The system of Claim 63, wherein said group is a subset of said plurality of slave devices.

65. The system of Claim 63, wherein the slave devices in said group have substantially the same capability.

66. The system of Claim 54, wherein said data in said second memory comprises message content of a message to and from said slave device.

67. The system of Claim 54, wherein said master device further comprises an operator interface.

68. The system of Claim 54, wherein said master device further comprises a battery for providing power to said master device.

69. The system of Claim 54, wherein said master device further comprises a second interface for communicating with an external network, said second interface being controlled by said microcontroller.

70. The system of Claim 69, wherein said second interface comprises:

a transceiver for transmitting and receiving data from said external network; and

a circuitry for communicating between said master device and said external network.

71. The communication system of Claim 52, wherein said second device is in an external network and said second device is coupled to said master device via a second communication path.

72. The system of Claim 71, wherein said external network comprises a second device, said master device negotiates with said slave device via said first communication path to determine whether to download a message from said second device to said slave device via said second communication path.

73. The system of Claim 71, wherein said external network is selected from the group consisting of an internet, a voice network, a second subnet, and a mobile unit.

74. The system of Claim 52, wherein said function comprises user interface.

75. The system of Claim 52, wherein said function comprises data source.

76. The system of Claim 52, wherein said first communication path is wireless.

77. The system of Claim 76, wherein said first communication path uses signals selected from the group consisting of digital radio frequency, analog radio frequency and InfraRed.

78. The system of Claim 76, wherein said first communication path is an air interface selected from the group consisting of advanced mobile phone service (AMPS), time division multiple access (TDMA), code division multiple access (CDMA) or global system for mobile communications (GSM).

79. The system of Claim 76, wherein said first communication path is established using a protocol selected from the group consisting of Bluetooth and wireless IEEE 1394.

80. The system of Claim 52, wherein said slave device is a pen phone.

81. The system of Claim 80, wherein said pen phone comprises a microphone electrically coupled to a transmitting circuit, said transmitting circuit transmitting data to said master device via said first communication path.

82. The system of Claim 80, wherein said pen phone comprises a speaker electrically coupled to a receiving circuit, said receiving circuit receiving data from said master device via said first communication path.

83. The system of Claim 80, wherein said pen phone comprises a circuit for ring indication.

84. The system of Claim 83, wherein said circuit for ring indication is selected from the group consisting of an internal vibrator, a ringer circuit and a beeper circuit.

85. The system of Claim 80, further comprising a voice recognition circuit for recognizing a voice input to a microphone and for performing a dialing operation based on said voice.

86. The system of Claim 85, further comprising a switch for enabling said voice recognition circuit.

87. The system of Claim 80, further comprising a jog-dial for selecting a phone number from a phone list stored in a memory at said pen phone.

88. The system of Claim 87, wherein the body of said pen phone rotates to jog phone numbers in said phone list.

89. The system of Claim 87, further comprising a select button to select the currently selected phone number.

90. The system of Claim 80, further comprising a display.

91. The system of Claim 90, wherein said display displays a currently selected phone number.

92. The system of Claim 52, wherein said slave device is a watch phone.

93. The system of Claim 92, wherein said watch phone comprises a microphone electrically coupled to a transmitting circuit, a speaker electrically coupled to a receiving circuit and an user interface.

94. The system of Claim 93, wherein said speaker flips out from the body of said watch phone and said microphone is attached to a wristband of said watch phone.

95. The system of Claim 93, wherein said speaker is separated from the body of said watch phone, further comprising a speaker wire connecting said speaker to said receiving circuit.

96. The system of Claim 93, further comprising a voice recognition circuit for recognizing a voice input to said microphone and for performing a dialing operation based on said voice.

97. The system of Claim 93, wherein said user interface is a keypad for performing a dialing operation based on positions of pressure-activated switches of said keypad.

98. The system of Claim 93, wherein said user interface is a jog-dial for selecting a phone number from a phone list stored in a memory in said watch phone.

99. The system of Claim 93, wherein said user interface is a touch-screen for performing a dialing operation.

100. The system of Claim 52, wherein said slave device is a wireless headset.

101. The system of Claim 100, wherein said wireless headset comprises a microphone electrically coupled to a transmitting circuit, a speaker electrically coupled to a receiving circuit and a user interface.

102. The system of Claim 101, wherein said microphone is separate from the body of said wireless headset.

103. The system of Claim 101, further comprising a volume control circuit for controlling said speaker.

104. The system of Claim 101, further comprising a voice recognition circuit for recognizing a voice input to said microphone and for performing a dialing operation based on said voice.

105. The system of Claim 101, further comprising hookswitch control for connecting and disconnecting said transmitting circuit and said receiving circuit and a call alert device for notifying a user of an incoming call.

106. The system of Claim 105, wherein the body of said wireless headset folds and unfolds for said hookswitch control.

107. The system of Claim 100, wherein said headset comprises a display for displaying status of said communication system.

108. The system of Claim 100, wherein said headset comprises a battery indicator for indicating battery status.

109. The system of Claim 52, wherein said slave device is a miniature wireless display device.

110. The system of Claim 52, wherein said second device is a second slave device in said subnet.

111. A communication device for performing an exclusive master function, comprising:

a first interface for linking to a slave device in a subnet, said communication device being a dedicated master of said subnet;

a second interface for linking to an external network;

a first memory for storing operating software, application software and device configuration information for said communication device;

a second memory for storing data; and

a microprocessor for controlling said first interface, said second interface, said first memory and said second memory.

112. The device of Claim 111, wherein said first interface comprises:

a transceiver for transmitting and receiving data from said slave device in said subnet; and

a circuitry for wireless communication between said communication device and said slave device.

113. The device of Claim 111, wherein said second interface comprises:

a transceiver for transmitting and receiving data from said external network; and

a circuitry for communicating between said communication device and said external network.

114. The device of Claim 111, further comprising a battery for providing power to components in said communication device.

115. The device of Claim 111, further comprising a display.

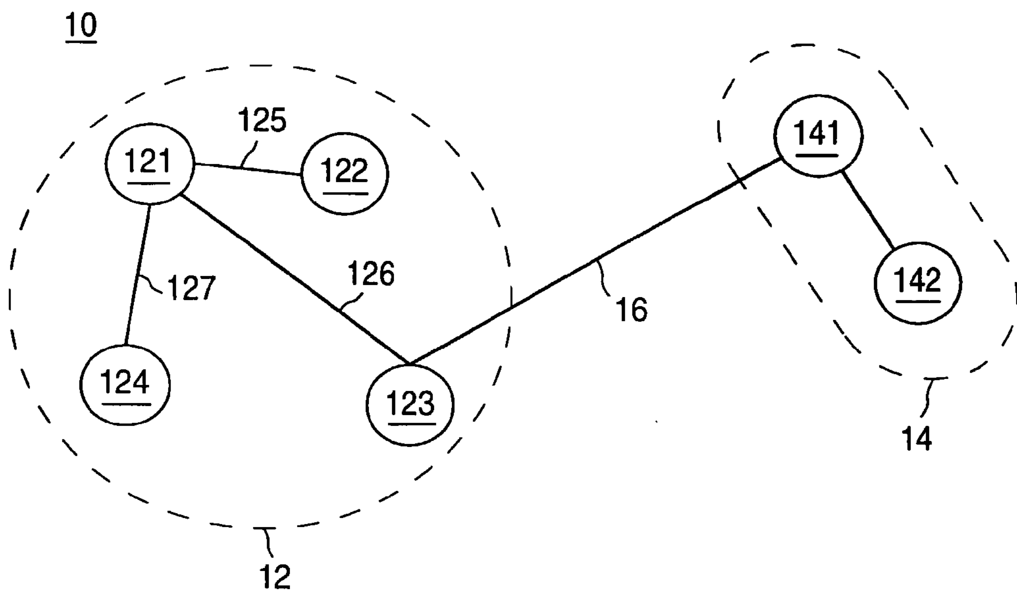

FIG. 1
(PRIOR ART)

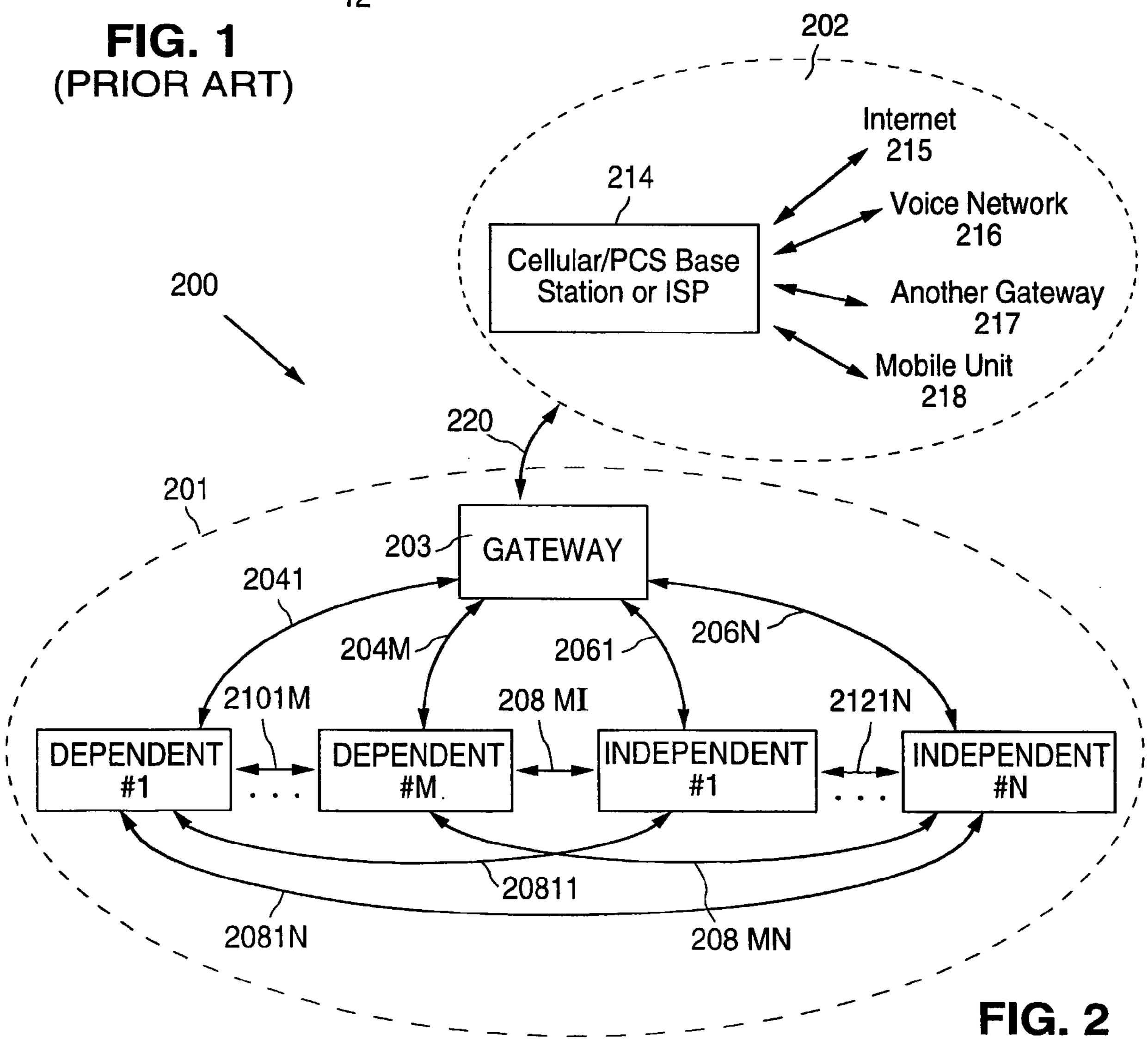

FIG. 2

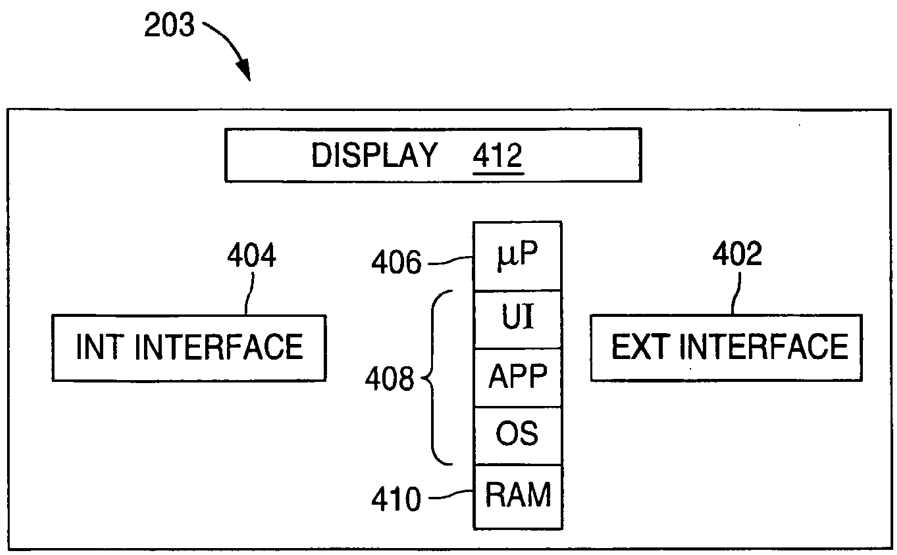
203
DISPLAY 412
404
406
μP
402
INT INTERFACE
UI
EXT INTERFACE
408
APP
OS
410
RAM

FIG. 3

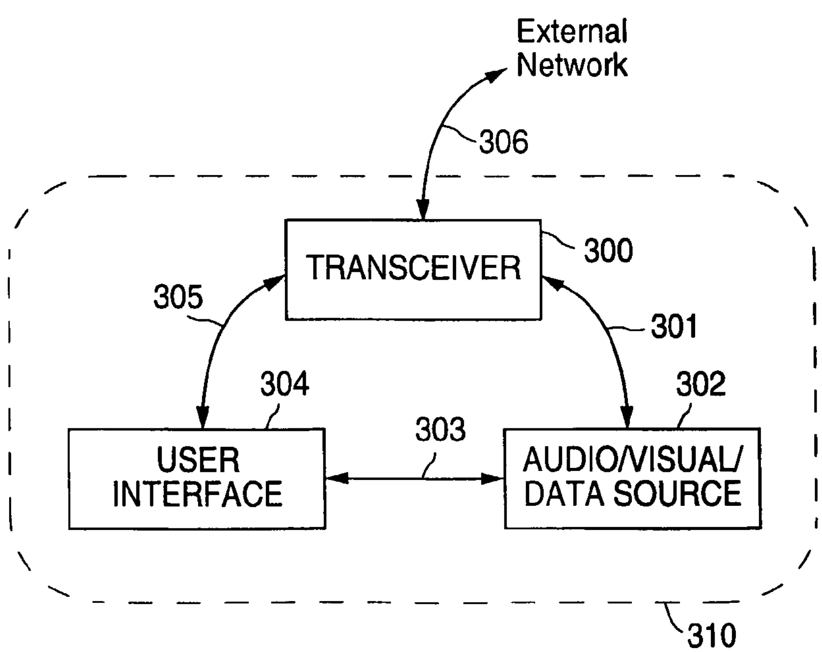
External Network
306
TRANSCEIVER
300
305
301
304
302
303
USER INTERFACE
AUDIO/VISUAL/ DATA SOURCE
310

FIG. 4

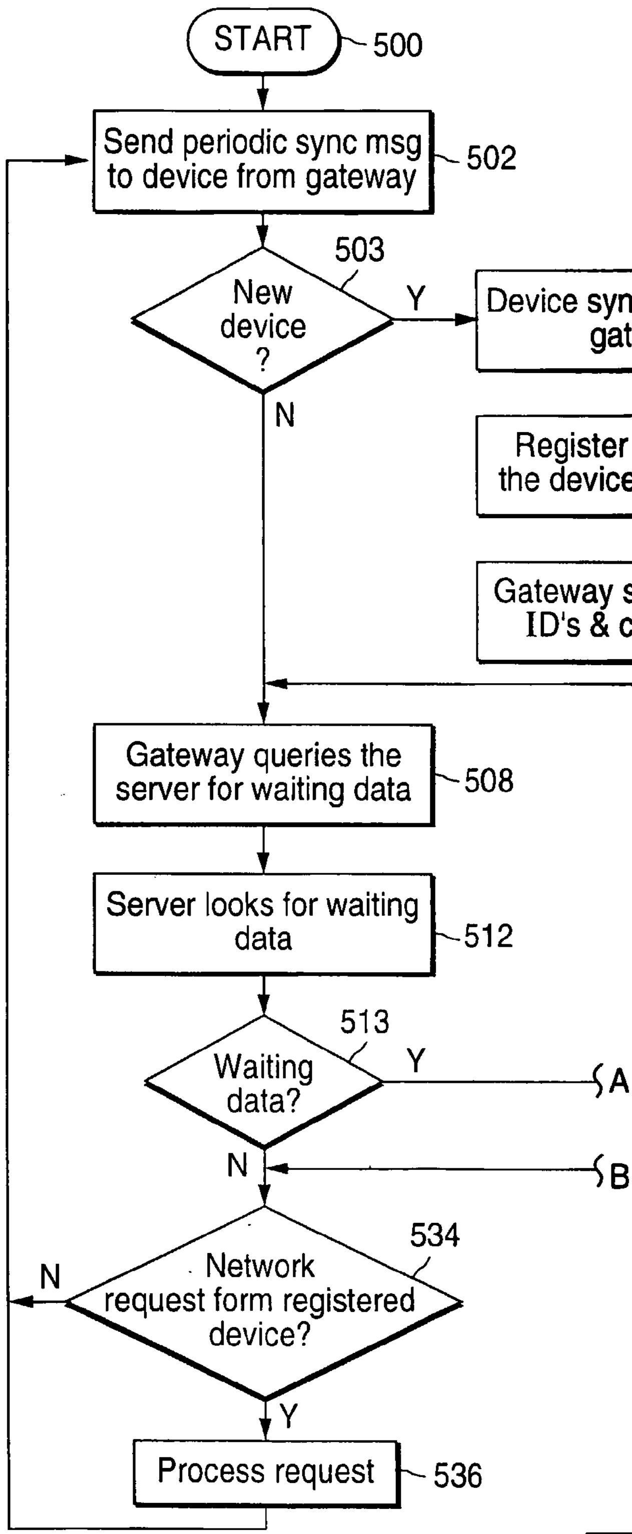

FIG. 5A

FIG. 5A	FIG. 5B

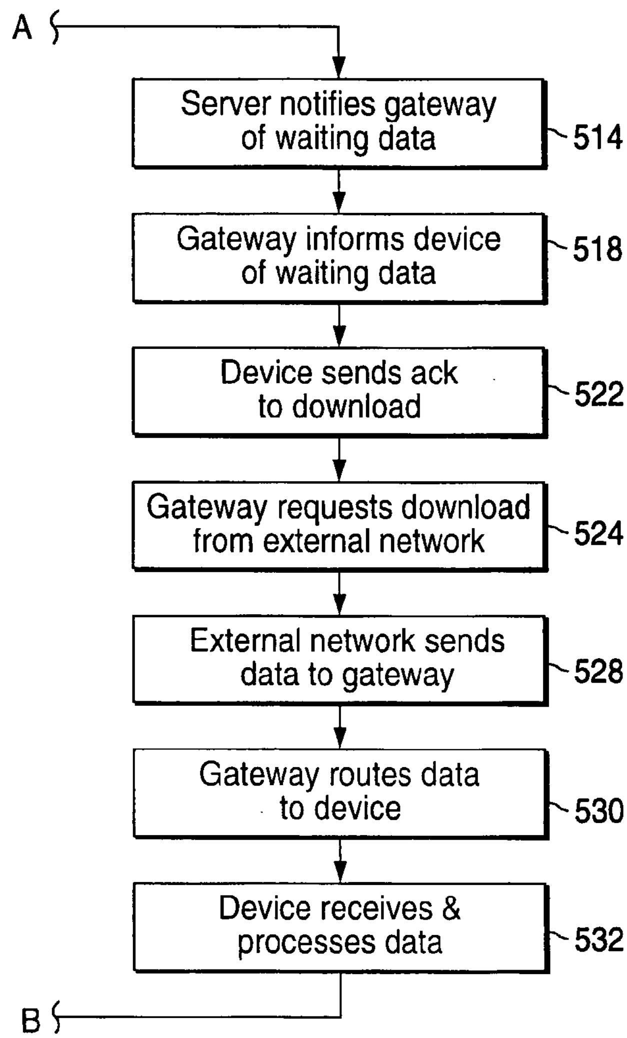
A
Server notifies gateway of waiting data
514
Gateway informs device of waiting data
518
Device sends ack to download
522
Gateway requests download from external network
524
External network sends data to gateway
528
Gateway routes data to device
530
Device receives & processes data
532
B

FIG. 5B

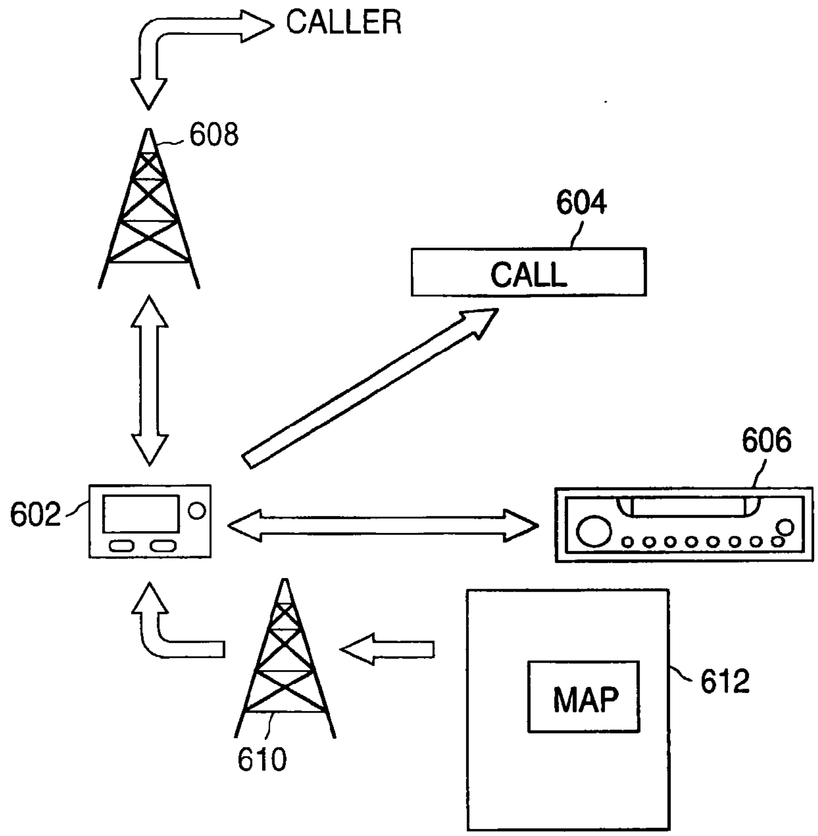
CALLER
608
604
CALL
606
602
612
MAP
610

FIG. 6

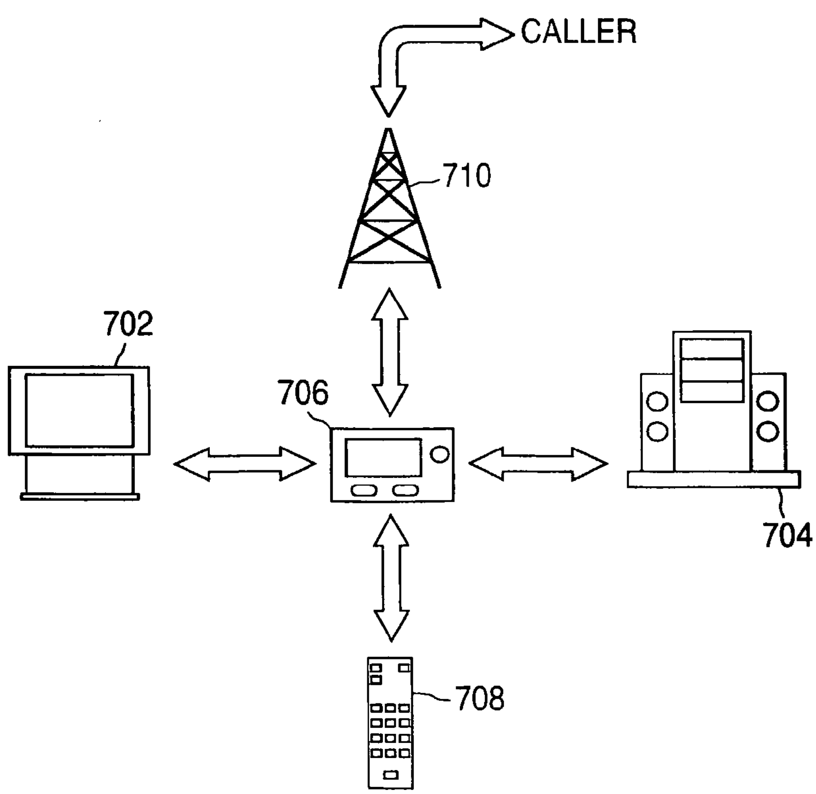
CALLER
710
702
706
704
708

FIG. 7

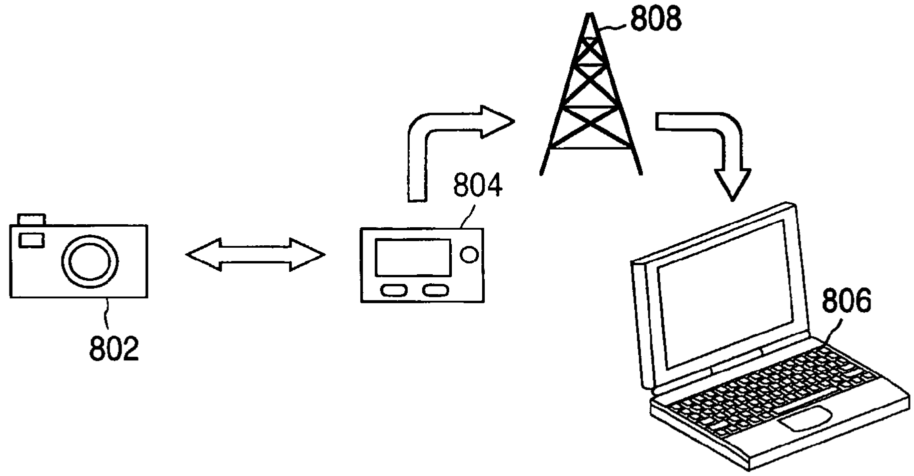

FIG. 8

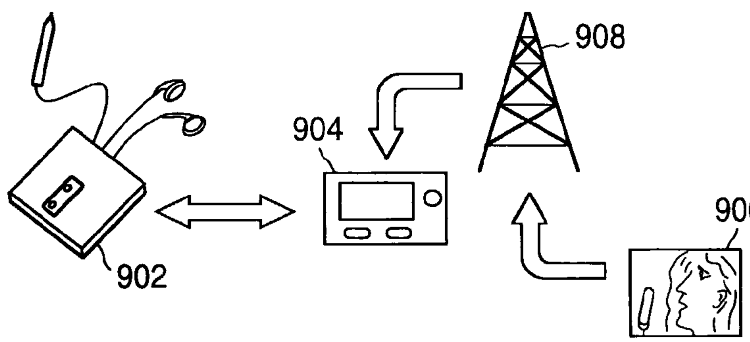

FIG. 9

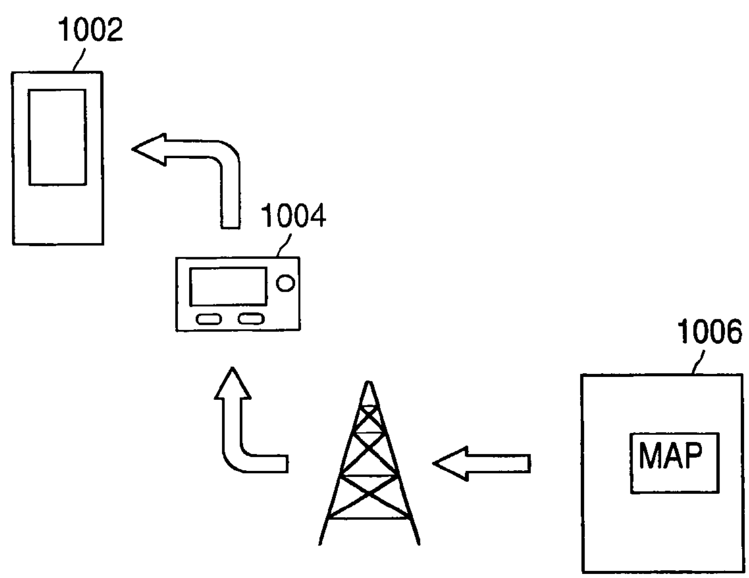

FIG. 10

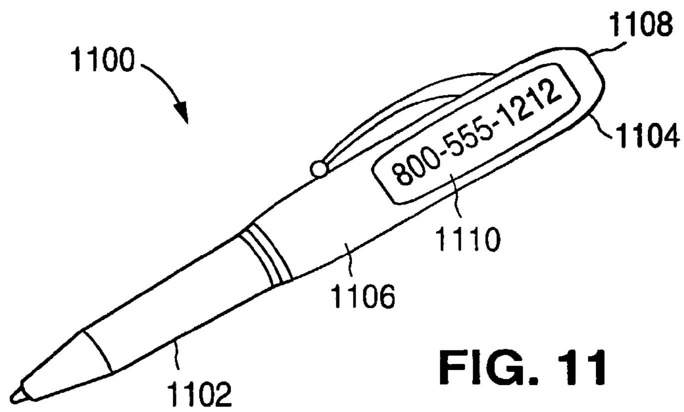

FIG. 11

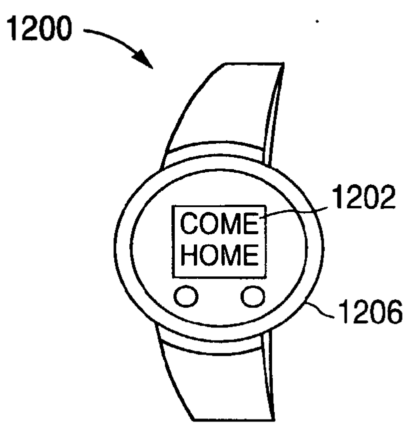

FIG. 12

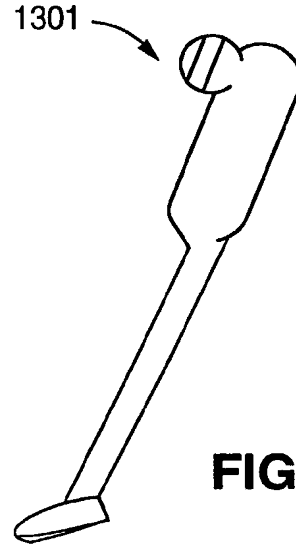

FIG. 13

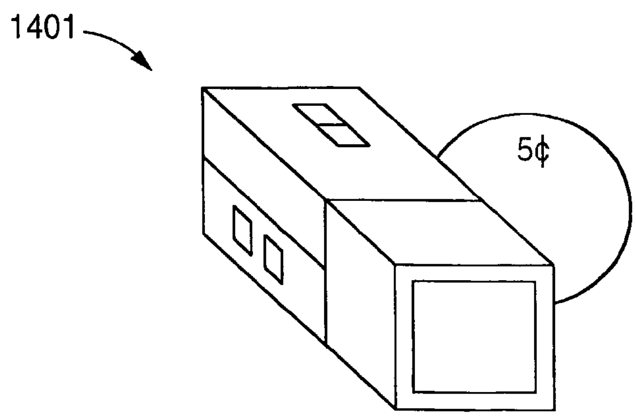

FIG. 14